B12 deficiency in children in Karabük city prevalence and key health insights

Eurasian Clinical and Analytical Medicine Original Research

B12 vitamin deficiency study with large-scale dataset

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Abstract

Aim: The primary objective of this study was to investigate the prevalence and characteristics of vitamin B12 deficiency among pediatric individuals residing in the Karabük region, with the aim of highlighting the significance of raising awareness and formulating effective management strategies to address this health concern..

Methods: The medical records of children under 18 who came to Karabük University Faculty of Medicine Training and Research Hospital in 2022 were retrospectively reviewed. Information such as B12 levels, demographic details, and blood parameters were examined using SPSS software.

Results: Out of 6133 children in the study, 1847 cases showed B12 deficiency or borderline deficiency. The prevalence of B12 deficiency was 4.5%, with 25.59% of children having borderline B12 levels. Children with B12 deficiency had a mean age of 11 years, and females had a higher prevalence in all age groups. Significant relationships were found between gender, age, and B12 levels.

Conclusion: In this study, it is revealed that many children in Karabük province suffer from vitamin B12 deficiency. This emphasizes the pressing need for more awareness and effective strategies to address B12 deficiency in children, especially in the pediatric population. It is highlighted that promoting vitamin B12, along with iron and vitamin D, in public health programs is crucial. More research and specific healthcare policies are necessary to tackle this issue successfully.

Keywords

vitamin B12 deficiency, children, prevalence, management strategies, hematological parameters

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Introduction

Vitamin B12 (B12), also known as cobalamin, is a water-soluble vitamin essential for human health as it cannot be synthesized in the body. Its primary sources include animal-based foods such as meat, dairy, eggs, fish, and shellfish.[1,2] Vitamin B12 plays crucial roles in the body, including nucleic acid and protein synthesis, lipid and carbohydrate metabolism, certain mitochondrial reactions, erythropoiesis, and myelination of the nervous system.[3,4] In cases of B12 deficiency, various hematological abnormalities such as megaloblastic anemia, thrombocytopenia, leukopenia, and hypersegmentation may occur, along with neuropsychiatric symptoms such as depression, anxiety, delirium, dementia, paresthesia, cognitive impairments, apathy, agitation, insomnia, concentration loss, and hallucinations.[5,6] In children, additional manifestations may include intrauterine growth retardation, growth and developmental delay, as well as cognitive dysfunctions in memory, attention, perception, and learning.[7,9]

In developed countries, despite absorption disorders and vegetarian or vegan dietary habits being significant contributors to B12 deficiency,[10,12] it is often observed in underdeveloped and developing countries due to low socioeconomic status. Factors such as inadequate dietary habits, low intake of animal products, and poor hygiene contribute additionally to this situation.[10] The most common cause in children is nutritional deficiency, with malabsorption and congenital B12 metabolism disorders being other significant factors.[10,11] In cases of Vitamin B12 deficiency, hematological abnormalities can be corrected with vitamin replacement therapy, whereas neurological symptoms are often irreversible.[13,15] Therefore, early detection and treatment of deficiency are crucial. Upon reviewing the literature, it has been observed that there are few studies conducted in our country within the last 5 years investigating the prevalence of B12 deficiency in children.[3,10,16,17,18,19]

It is well recognized that Vitamin B12 is essential for children, even during intrauterine life, and it is indispensable for the healthy completion of neurological and physical development.[6] Its impacts on education and learning are significant, especially considering the irreversible nature of neurological disorder.[6] Therefore, early detection and treatment of B12 deficiency are paramount. In this study, we aimed to retrospectively analyze pediatric patients presenting to our hospital for any reason and diagnosed with B12 deficiency; the frequency of Vitamin B12 deficiency, distribution according to age groups, and evaluation of hematological parameters were intended to be assessed.

Material and Methods

Data Design

The medical records of patients under the age of 18 who presented to the Karabük University Faculty of Medicine Training and Research Hospital in the year 2022 were retrospectively reviewed. Patients diagnosed with certain codes according to the ICD coding system (D51, D51.9, D51.0, D51.1, D51.3, D51.8, Y44.1) were included in the study. Those who had their vitamin B12 levels checked were selected for inclusion. Accordingly, it was determined that the B12 levels of 6133 patients were tested. Additionally, a detailed exploration of those among these 6133 patients with low B12 levels was planned. A total of 1847 patients were included in the study based on the defined criteria.

Study Settings: Vitamin B12 levels below 200 pg/ml were considered deficient, and those between 200-300 pg/ml were considered borderline deficient. [3] The hematological data of the patients included in the study were checked and recorded from the database.

Statistical Analysis: The data obtained in the study were evaluated using SPSS for Windows (Version 20.0, Statistical Package for Social Sciences) program. The distribution of the data was examined according to Skewness/Kurtosis values, and it was determined to be suitable for normal distribution. Descriptive statistics for continuous variables were presented with mean and standard deviation values, while descriptive statistics for categorical variables were shown with frequency and percentage. Comparisons between categorical variables were made using Chi-square analysis. Comparisons with a p-value below 0.05 in statistical analyses were considered statistically significant.

Ethical Approval

This study was approved by the Ethics Committee of Karabük University (Date: 2023-12-07, No: 2023/1566).

Statistical Analysis

The data obtained in the study were evaluated using SPSS for Windows (Version 20.0, Statistical Package for Social Sciences) program. The distribution of the data was examined according to Skewness/Kurtosis values, and it was determined to be suitable for normal distribution. Descriptive statistics for continuous variables were presented with mean and standard deviation values, while descriptive statistics for categorical variables were shown with frequency and percentage. Comparisons between categorical variables were made using Chi-square analysis. Comparisons with a p-value below 0.05 in statistical analyses were considered statistically significant.

Reporting Guidelines

This study was reported in accordance with the STROBE guidelines.

Results

Our research involved a group of 6133 healthy children, out of which 1847 cases showed either a deficiency or borderline deficiency of vitamin B12. That means 4.5% of the children had B12 deficiency, while 25.59% had borderline B12 levels. Overall, it was revealed that 30.11% of the children needed B12 supplementation. The sociodemographic details of the children in the study can be found in Table 1. The average age of the children in the study was 11.2 ± 5.52 years, with 60.2% being

Table 1. Sociodemographic characteristics of children ıncluded in the study

Characteristic	Mean ± SD	
Age (year)	11,2 ± 5,52	
Gender	n	%
Female	1112	60,2
Male	735	39,8
B12 Level (pg/ml))		
Deficiency	277	15
Borderline	1570	85
Gender	**Yaş**	
	Mean ± SD	
Female	11,98 ± 5,32	
Male	10,01 ± 5,61	

Table 2. Hematologic values of cases ıncluded in the study

Blood Values	Mean ± SD	Min - Max
Vitamin B12 (pg/ml)	244,52 ± 39,54	59-300
Hb (mg/dl)	12,77 ± 1,54	4,3-17,6
MCV (fL)	81,65 ± 6,56	52,3-98,3
RBC (10^6/µL)	4,74 ± 0,44	1,95-6,75
PLT (10^3/L)	302,86 ± 83,01	10-852

Table 3. Comparison of B12 levels among cases by gender

Gender	B12 Deficiency (<200)		B12 Borderline (200-300)		Total B12 (<300)		Test Req.*	p value
	n	%**	n	%**	n	%**		
Male	125	45,1	610	38,9	735	39,8	3,88	0,04
Female	152	54,9	960	61,1	1112	60,2		
Total/Overall	277	100	1570	100	1847	100		

*Chi-square test, **Column percentages were calculated.

female and 15% having B12 deficiency.When examining the relationship between gender and age levels, it was found that the age of males (10.01 ± 5.61 years) was lower compared to females (11.98 ± 5.32 years) (Table 1). The mean values of Vitamin B12, Hb, MCV, RBC, and PLT for the cases included in the study were determined as follows: Vitamin B12: 244.52 ± 39.54 pg/ml, Hb: 12.77 ± 1.54 mg/dl, MCV: 81.65 ± 6.56 fL, RBC: 4.74 ± 0.44 10^6/µL, and PLT: 302.86 ± 83.01 10^9/L (Table 2). Our patient with the lowest B12 level (59 pg/ml) was an 8-month-old girl, with Hb at 6.1 mg/dl, and MCV at 95.9 fL. Megaloblastic anemia was considered as a preliminary diagnosis in the patient with normal iron parameters.

The comparison of B12 levels among the cases by gender is presented in Table 3. The analysis revealed a significant association between gender and B12 levels (p=0.04). It was observed that B12 deficiency was more prevalent in females (54.9%) compared to males (45.1%) (Table 3). The analysis revealed a significant association between age and B12 levels (p=0.01). It was observed that the highest proportion of B12 deficiency cases, 75.1%, were among those over 5 years old, followed by 18.4% in those under 2 years old, and 6.5% in children aged 2-5 years.

Discussion

The association between vitamin B12 levels and gender remains a contentious subject in the literature.[20,24] In the most extensive cohort study conducted in our country, involving the analysis of blood samples from 30,504 individuals, no significant correlation was detected between B12 levels and gender.[20] However, smaller-scale cohort studies have indicated a predominance of males.[20,24] In contrast to these findings, our research revealed a prevalence of B12 deficiency among females across all age brackets. These findings suggest that gender may serve as a significant determinant in B12 deficiency. To gain deeper insights into these observations, further comprehensive research is imperative to elucidate the intricate relationship between B12 deficiency and gender. Consequently, healthcare policies and clinical practices should adopt a more nuanced approach to the early detection and management of B12 deficiency, taking into account gender-based disparities.

In our research, we looked at a group of 6133 patients who were thought to have a lack of B12, with 1847 of them showing either a deficiency or borderline deficiency. This is the second-largest group studied in our country. Previous research typically focused on certain age ranges, but we included people under 18 years old in our study, with an average age of 11.2 ± 5.52 years. In alignment with previous research spanning age groups,[3, 15, 16] our results reaffirm the widespread implications of B12 deficiency across various age brackets. Our findings underscore the importance of heightened vigilance regarding B12 deficiency, particularly among sensitive age groups such as children and adolescents. Therefore, any steps taken by health policy regulators should prioritize targeting specific age groups to address this issue effectively.

In our research, we further analyzed B12 deficiency levels, specifically those below 200 pg/ml and borderline levels ranging from 200-300 pg/ml, categorized by age. Our analysis revealed that the age group with the highest prevalence of both B12 deficiency and borderline levels was individuals aged 5 and older, while those under 2 years old had the second highest frequency. Another study also found a higher occurrence of B12 deficiency in older age groups.[4] Similarly, a study in Zonguldak province observed a significant rise in B12 deficiency frequency with age when comparing patients aged 6-10 years to those aged 11-14 years.[18] These results highlight the importance of age as a contributing factor to B12 deficiency and emphasize the need for age-specific approaches in its management.

According to our findings, in Karabük province, we observed that 4.5% of children exhibited B12 deficiency, while 25.59% had borderline B12 levels. Additionally, a total of 30.11% of children were identified as requiring B12 supplementation. When we look at other provinces in the Black Sea region, which is the third most populous region in Turkey, some studies have reported incidence rates ranging from 18% to 30%. For instance, a study conducted in Zonguldak province and published in 2021 reported a B12 deficiency rate of 33% among 392 healthy children in the cohort.[18] Similarly, in another study conducted in Amasya province and published in 2023, the rate of B12 deficiency was determined to be 18% among 240 cases.[4] Moving outside the Black Sea region, a study conducted in Istanbul and published in 2022 reported B12 deficiency (4%), borderline B12 levels (18%), and total B12 insufficiency (22%) among 3115 cases.3 The most comprehensive study in our country, conducted by Eroğlu et al., with 30,504 cases, reported a prevalence of 27%.[20] The rate of 30% in our study is quite close to the 27% reported by Eroğlu et al.[20] This indicates that the results of the first two largest studies with the most extensive dataset in our country are consistent with each other, demonstrating that the rate of B12 supplementation need in Turkey ranges between 27% and 30%.

Our study revealed an average vitamin B12 level of 244.52 ± 39.54 (pg/ml). The inclusion of patients with low B12 levels (<300 pg/ml) in our study, along with our balanced sample size, may have contributed to more reliable results. Indeed, a study by Eroğlu et al,[20] also reported a B12 average similar to ours, further supporting the consistency of our findings.[20] Similarly, a study involving 161 participants aged 0-18 years reported a mean B12 level of 167.70 ± 45.17 (pg/ml).[16] This finding can provide clinicians with a more reliable guidance when assessing B12 deficiency.

Conclusion

This study gives us important information about how common B12 deficiency is among children in Karabük province. It shows us that many children are affected and highlights the need for increased awareness and comprehensive strategies to manage B12 deficiency, especially among children who may be facing challenging socioeconomic conditions. The findings tell us that almost one in three children has B12 deficiency, so it's crucial to include B12 alongside iron and vitamin D in public health initiatives. Healthcare policymakers should take this information into account and develop targeted support for different age groups.

Ethics Declarations

The study protocol was reviewed and authorized by the Ethics Committee of Karabük University (Date: 2023-12-07, No: 2023/1566) and was conducted in accordance with the principles of the Declaration of Helsinki.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Data Availability

The data supporting the findings of this article are available from the corresponding author upon reasonable request, due to privacy and ethical restrictions. The corresponding author has committed to share the de-identified data with qualified researchers after confirmation of the necessary ethical or institutional approvals. Requests for data access should be directed to bmp.eqco@gmail.com

Conflict of Interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

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